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A PROCESS MODELING APPROACH TO REQUIREMENTS ELICITATION TO INCORPORATE E-LEARNING AS A CORE LEARNING STRATEGY

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ABSTRACT

The purpose of this paper is to describe a methodology for *requirements elicitation* of traditional higher educational environments in order to gain a comprehensive understanding of the critical processes of this application domain. Such an understanding might be instrumental in the strategic planning and the realizing of e-learning implementations that are both successful in achieving learning goals, and are also completely integrated into all critical processes with positive acceptance from stakeholders. The methodology uses the basic underlying theoretical principles of requirements analysis. Through experimentation and research, the methodology was designed to accelerate the requirements engineering process and as a result reduce the initial cost of systems development. In its layout, the paper briefly considers the theoretical criteria for a requirements elicitation before proposing the methodology. Its functionality is illustrated by means of a case study discussion.

INTRODUCTION

Advances in information technology, the Internet and evolving e-learning strategies over the past few years have led to the rise of many new learning organizations offering "virtual" certification programs to geographically dispersed students (Singh, 2000). These types of *virtual universities* are often based on the co-operation between different educational institutions, courseware specialists and course brokering companies, and most of them offer formal, as well as informal programs (Belmiro & Pina 2001). However, there is also a trend to include e-learning[1] programs in the formal curricula of traditional universities and colleges. Indeed, traditional higher education institutions that have already incorporated e-learning into their curricula often claim to have a competitive advantage in serving a wider audience of students.

The incorporation of e-learning into the curricula of traditional higher education institutions is not simple. It involves many complex issues such as strategic management decisions, strategic information technology plans, change management to enhance the willingness to participate and commitment of stakeholders, training and retraining, selection of suitable learning strategies, partnership strategies, development of courseware, and so forth (Young 2001). Because the full scope of the application domain is not always considered when e-learning programs are adopted, it is common that stakeholders are frustrated with their working conditions, and often also become resentful of e-learning as a method of learning. The main cause of the dissatisfaction with, and inefficient implementations of e-learning can often be traced back to a failure to understand the complete application domain that is subject to the roll out of e-learning technologies and strategies.

Inadequate understanding of the organizational structure, processes and culture of the application domain will probably eventuate in the skepticism of e-learning integration into the working environment. This might be, despite the fact that specific strategies and technologies might have been introduced to automate and support traditional processes. The research question that we concern ourselves with is, how an institution can effectively identify the key institutional processes that would either be playing a primary role in the adoption of e-learning or be subject to key changes in such an adoption? This type of task is commonly assigned to management or business consultants where a large amount of time is spent on requirements elicitation. The purpose of this paper is to describe a methodology for the requirements elicitation of an educational environment in order to gain a comprehensive understanding of the critical processes of this application domain. The methodology that is proposed in this paper is aimed at institutions that share a common profile, namely

[1] Also commonly called virtual learning, telematic learning or teleteaching

traditional tertiary or higher education institutions. The methodology may be adapted for other business types, but the results that are reported in this paper are focused on the traditional higher education profile commonly found in colleges and universities.

The activity of *requirements elicitation* in order to understand an application domain is commonly be a tedious, and hence expensive process that is usually impeded by political and social agendas, conflicts and individuals promoting their own projects and activities (Wang 1999). Although it might be impossible to develop a completely neutral or objective model of an organization, the use of a set of scientifically founded guidelines may render a sufficient valid and appropriate model. Many researchers and practitioners have suggested and used process models as a tool to analyze (and design) conventional and extended enterprises and institutions (Belmiro & Pina 2001, Kraiem 1997, Lehman et al. 2001, Presley Liles 2001). According to Curtis et al. (1992) process models can be used in obtaining high-level prescriptive processes representative of the institution and are also able to produce precise, unambiguous and comprehensive descriptions of the relevant processes.

The methodology proposed in this paper suggests a set of guidelines that contribute to developing a *high-level process model* that describes the key processes representative of an educational institution and through which the institution could be understood. This understanding will contribute to the possible success of future e-learning implementations by means of the early identification of critical processes in the application domain, which gives the institution the opportunity to strategically prepare for the adoption and integration of e-learning components into its environment. This can be particularly useful to new implementers, but also to implementers who aim to improve their e-learning programs. Our methodology enables the latter to return to the drawing board and single out processes that were previously neglected.

The paper proceeds by briefly considering the basic principles of requirements elicitation leading to a discussion of the proposed methodology. This is followed by a case study discussion illustrating how we used the proposed methodology to gain an understanding of the critical processes of a higher education institution. Finally we conclude with a short review and future research plans.

CRITERIA FOR REQUIREMENTS ELICITATION

A common description of *requirements* is that it is a statement describing services or constraints relevant to a specific aspect of an institution (Kotonya & Sommerville 1998, Robertson & Robertson 1999). To position our paper, we briefly distinguish between two terms that are often used interchangeably namely, requirements elicitation and requirements analysis. *Requirements elicitation* is described as the systematic extraction and inventory of the requirements of a system (IEEE, 1998). The focus is on bringing out information from the application domain rather than concentrating on the application itself. The objective of *requirements analysis*, on the other hand, is to establish a set of unambiguous requirements that can be used as basis for system development (Kotonya & Sommerville, 1998). The focus is therefore on the application to be developed for deployment in a specific application domain. In this paper, our focus is not on e-learning applications, but rather on gaining a thorough understanding of the application domain where e-learning systems can be deployed. Several contexts of comprehension are commonly associated with requirements elicitation namely (1) domain understanding, (2) problem understanding, (3) business understanding, and (4) understanding the needs and constraints of the system stakeholders (Kotonya & Sommerville, 1998, Christel & Kang, 1992). The first context refers to the importance of understanding the institution in which the intended system will be deployed, i.e. the activities focusing on gathering domain knowledge. The second refers to an understanding of the intended system's mission within the organizational context, and assists in extending the general domain knowledge by acknowledging the objectives of the system to be considered. We illustrate the importance of this context by considering an example: For a planned e-learning system, the focus of the elicitation will be on processes that pertain to automation and integration with other systems. In contract to this, a planned financial system shifts the focus to monetary aspects of all the processes in the company. The third context augments the first two by clarifying how the business rules of an institution will contribute to an understanding of how different systems in the institution should interact. The final context refers to the importance of understanding the work processes that the intended system has to support in order to accommodate existing systems and their stakeholders.

Some of the most popular methods of requirements elicitation include interviews, questionnaires, scenarios, brainstorming, facilitation, observation, social analysis, requirements reuse, study of documents, and software systems (Atlee & Berry 2002, Kotonya & Sommerville 1998, Maciaszek 2001). Methods such as prototyping, JAD (Joint Application Development) and RAD (Rapid Application Development) focus on the intended system, and are therefore not typical of *requirements elicitation* as we consider it in this paper, but rather pertain to the *requirements analysis* definition given earlier. We based our methodology on all of the above requirements elicitation techniques and developed a procedure for the construction of a high-level process model embodying the knowledge of the chosen application domain.

Kotonya & Sommerville (1998) suggest four critical activities to be included in a good requirements elicitation procedure namely (1) objective setting, (2) background knowledge acquisition, (3) knowledge organization and, (4) stakeholder requirements recollection. In the *objective setting* activity, the overall organizational objectives are established where the business goals, problems to be resolved, and possible constraints are considered. The *background knowledge acquisition* activity involves information gathering about the organizational structure, the application domain, as well as the existing systems. In the *knowledge organization activity*, the knowledge that was previously collected has to be organized and collated. Specific focus is placed on goal prioritization and domain knowledge filtering. Finally, the stakeholder *requirements collection activity* involves the consultation with system stakeholders to discover specific requirements originating from the application domain that acquires the intended system. Our methodology includes all these critical activities, as illustrated in Figure 1.

METHODOLOGY

Figure 1 shows the phases of our methodology as a spiral model, where, the different phases are not discrete activities, but are interleaved and revisited many times to build a complete high-level process model. These phases also correspond to the critical activities mentioned in the previous paragraph.

The result of phase 1 is the establishment of objectives, whereas the *Identification of critical institutional* units (Phase 2) and the *Identification of primary processes* (Phase 3) assist in understanding the domain. Stakeholder requirements are also collected and collated during these two phases. The acquired information is then organized into a high-level process model, which is refined in the final step into several sub-process models. We subsequently describe each phase.

Phase 1: Establish high-level objectives

In Phase 1, the requirements engineering team, in co-operation with stakeholders, compiles a detailed description of the higher-level purpose of the requirements elicitation exercise. At this stage, the stakeholders usually comprise of members of the management of the institution as the higher-level purpose focuses on approval for the adoption and integration of new systems affecting the entire organization. If management does not actuate the requirements elicitation initiative, it is at least essential that approval and collaboration commitment be secured before continuation. This is necessary because one of the primary causes of unsuccessful or rejected projects is the failure to establish upper-management commitment to these projects (Singh 2000, Whitten et al. 2000).

The deliverable of the first phase is a descriptive document acting as a framework available for future reference and verification purposes. A document of this nature includes a short description of the goal(s) as well as a clear specification of the required deliverables. Typically, it includes a single the primary goal supported by one or more secondary goals. A primary goal rationalizes the reason for performing the requirements elicitation exercise, acting as guidance throughout the elicitation exercise and also during development and deployment of the intended systems. A lack of awareness of primary goal might cause the requirements engineering team to become unnecessary diverted leading to expensive time delays. The secondary goals serve as a refinement of the primary goal and often also embody constraints within the application domain.

Phase 2: Identify critical institutional units

As stated earlier, our objective is to identify the critical processes in our application domain in order to examine their essential activities and workflow, so that the application domain can be understood. These processes can only be identified by considering the different operational units[2] within the institution. As a first step, all these units within the institution are listed – this can be done by studying documentation and diagrams such as organizational diagrams or through interviews. With our focus on possible adoption and integration of e-learning, the second step involves extracting those units that are actively involved in the creation and presentation of learning environments. Units focusing on other aspects of the institution are then labeled as *support units* and are deleted from the unit list. For example, the Catering Services department prepares refreshments but is not directly responsible for, or involved in the learning environment, and will therefore be removed form the unit list. The deliverable of phase 2 is a listing of the critical operational units of an institution.

Phase 3: Identify primary processes

In the next three phases we use a formal approach to identify the relevant processes. In the case of small institutions, identification of core processes and follow-up results are generally simple, but the complexity often increases dramatically with the size of an institution. The

[2] A unit refers to a working segment of the institution that is responsible for specific tasks for example a financial section, an academic department, a technical division, et cetera.

use of a formal approach to describe a specification provides us with the means to:

- accurately and concisely present the detail;
- unequivocally express the interpretation we assign to specific aspects;
- make the different results portable, reusable and extensible; and
- be both operational and expressive (Cloete & Kotzé, 2003).

We distinguish between *primary*[3] and *support*[4] processes in the application domain. The purpose of phase 3 is to identify the primary processes in each of the critical units of the application domain.

The Process Model Inc. (1997) suggests that identification of primary or core processes is a first step towards constructing a process model. Porter (1985) identifies five primary activities in the business environment contributing to the value of businesses. Applying the fundamentals of his work to the educational application domain yielded a list of primary processes applicable to this domain. This list should only be considered as a starting list since modifications or expansion might be necessary to correctly and completely describe the application domain. The elements of the starting list include:

- registration process (REGISTRATION),
- development of course material (COURSE DEVELOPMENT),
- production of course material, (at residential universities, this activity is often embedded in the development of course material, while it forms a separate process in distance learning universities.)
- (PRODUCTION), distribution of course material (DISTRIBUTION), and
- academic support available to the student (ACA STUDENT SUPPORT).

The following steps can be used to expand the above list and to verify its adequacy and completeness. These steps should be applied to the unit list created in the second phase, and repeated for each of unit.

1. List and document the most important processes of the particular unit in order to establish the main duties within the unit. The focus is on the goals to be achieved rather than on the individual activities that might realize these goals. A general guideline is to include *what-processes* rather than *how-processes*. (A *what-process* is goal-oriented in its description, expressing the objective of the particular process, while a *how-process* is action-oriented, explaining the particulars of specific activities to accomplish the specified goal).
2. Categorize each process as either being a support or a primary process using to the definitions provided above.
3. Attempt a mapping for each of the newly identified primary processes to an item on the starting list. A process list is created from items on the starting list that correspond to primary processes through their mappings, whilst primary processes that cannot be mapped are added as new items on the process list.

The deliverable of Phase 3 is a process list consisting of set of the identified primary processes, namely

$$\{P_k\}_{k=1}^{m} \text{ with } k, m \in \mathbb{N}, \qquad (1)$$

where m denotes the total number of processes for all critical operational units.

Eriksson & Penker (2000) comment that it is unusual, even for a complex environment, to have more than ten primary processes and advise modelers to identify only between five and ten primary processes portraying the high-level duties that add value to an organization. In the case of more than ten processes, we advise the requirements engineering team to reconsider individual items on the process list and, where possible, combine items with close associations. A model with too many processes is complex to interpret and as a result looses some of its functionality intended to improve understanding.

Phase 4: Construct the high-level process model

Process modeling presents a technique (involving several activities) to graphically depict the series of processes that accomplish a predefined goal (Curtis et al. 1992, Snowdown (2002). A *process model* is a *structure* that represents a group of processes and their relationship to one another together accomplishing a specific goal. A *high-level process model* on the other hand, is defined as the structure depicting all the *primary processes* and their relation to one another to accomplish the high-level objectives of the modeling exercise. From this explanation, it is apparent that for a specific application domain, there is only one high-level process model and possibly several smaller (sub) process models to augment and refine the high-level process model. To achieve the said objectives, our methodology not only involves the activities to create a high-level process model, but also the essential (sub) process models.

There are a number of significant elements that are used to depict a particular process, and different process

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[3] *Primary processes* are those critical activities responsible for, or involved in the design and construction of the student's learning environment.

[4] *Support processes* are those processes that provide sustenance for the primary processes playing a secondary role in accomplishing the defined goal

modeling methodologies suggest different significant elements all depending on the specific application domain. Wang (1999) describes different elements for a process model, including an activity, a task, input/output, roles and a user. Eriksson and Penker's (2000) provide a higher abstract of these elements to include the process itself, process resources, and the goal description of the process. Process resources can either be *input* or *output* resources. An *input resource* is used to assist in the flow of process activities. For example, in a student registration process, the registration form (input) is used (initially) to capture the student information. An *output resource* is the resulting output of the activities in a specific process, and in turn might potentially serve as an input resource to another process. Each process has at least one input resource and one output resource associated with it. The first construction step towards the high-level process model is to define the goal, input resources and output resources associated with each item on the process listing created in the previous phase. At the end of this step, a set of all the resources for primary processes of the application domain can be described as:

$$\{R_j\}_{j=1}^{n} \text{ with } j, n \in \aleph \qquad (2)$$

with n denoting the total number of resources.

The second step is to indicate the workflow between the different primary processes through input and output resources. This task remains simple as long as there is only a small number of primary processes to consider and can be done by simply connecting related processes through directed lines. However, as the number of primary processes increases the complexity to depict the workflow also increases considerably. In such a case, we suggest a more formal approach to establish relationships between primary processes. We subsequently describe this approach to resolve complexities in establishing relationships between primary processes.

Our objective is to identify the resources that serve as both input and output resource for the different processes and then eliminate redundant resources (those resources that would appear more than once on the same process model diagram). To identify these resources, determine the association value (say T_{kj}) that a resource R_j has with a process P_k (for all j and all k). These association values may be INPUT (T_{kj} = I), OUTPUT (T_{kj} = O), or *no* association (T_{kj} = 0). Each T_{kj} is then stored as an entry in a process-resource table, which vertically tabulates all processes from top to bottom and horizontally tabulates all resources from left to right.

The following steps assist in indicating the workflow and associations between the different processes, and as a result describe the high-level process model.

- For k = 1..m and j = 1..n, describe the all the resources in terms of their association values with P_k. This is written as a triplet (P_k, R_j, T_{kj}). (Zero values can be ignored.)
- For k = 1..m, graphically depict P_k on a diagram with its associated goal.
- For j = 1..n, add the identified resources, R_j to the diagram.
- Use the set of triplets (identified in 1), in particular the third coordinate, to add directed lines between processes and resources.

This approach produces the high-level process model for the application domain.

Phase 5: Refinement

As mentioned earlier, a complete understanding of the application domain is depicted through a single high-level process model with several smaller (sub) process models to accomplish the intended goal. The purpose of the refinement phase is to decompose and particularize the individual processes in the high-level process model through iterative steps into a set of sub-processes or atomic activities[5].

The activities required to depict the mentioned sub-models are similar to those described in the previous phase for the high-level diagram.

In summary:

- For each (primary[6]) process, identify the set of affiliated sub-processes involved in the generation of its output resource(s).
- For each sub-process, define its associated goal, input and output resources.
- Associate the sub-processes with one another through input and output resources as described in the phase 4.
- Draw the process model, which graphically depicts the sub-processes and their relationships between one another.

Repeat these steps for each of the identified sub-processes until all processes are atomic *or* the requirements engineering team decides against further refinement. The deliverable of this step is a set of smaller (sub) process models augmenting the high-level process model.

CASE STUDY DISCUSSION

[5] An atomic activity is a process that cannot be broken into further sub-processes.

[6] Will be a sub-process during further refinement.

We have applied the proposed methodology to four different traditional higher education institutions, and for each institution found that we were able to assist the institutions in their requirements elicitation process in a very short time. Participants were all very excited about the use of our methodology to identify their core processes for various application purposes. Most of these participants commented that application of the methodology assisted them in overcoming political or social agendas, and provided them with accurate institutional information in a very short time when compared to their previous experiences in this regard. In this section we illustrate how the methodology was used in one of these institutions to construct a high-level process model in order to understand the institution. We describe the modeling process of the University of South Africa (Unisa), which is a mega distance-learning institution with more than 130 000 students worldwide.

Phase 1: Initialization

During the first phase, we compiled a descriptive report that depicts the primary goal, secondary goal, as well as the intended deliverables. The authors have been involved at Unisa in strategies to adopt best practices in e-learning and e-learning standards over the past four years. During this time, many interviews, both formal as well as informal have taken place. The main goal seemed to be to find and apply the best e-learning strategies in order to promote e-learning as one of the core teaching strategies. Yet, many of these efforts seemed to fail. It was then that the primary goal was redefined as the necessity to acquire domain knowledge in order to gain a comprehensive understanding of the critical processes at the institution. Once the primary goal was redefined, it became possible to achieve the secondary goal namely to use this domain knowledge as a basis from where strategic innovative internet-based activities can be developed and existing e-learning implementations can be enhanced.

The following deliverables (reports) were identified corresponding to the different phases:

- A listing of the critical institutional units;
- A listing of primary processes in the identified critical units;
- A diagrammatic representation of a high-level process model for the institution portraying the primary processes and their relationships to one another;
- A diagrammatic representation of the sub process models augmenting the high-level process model.

Phase 2: Identify the critical institutional units

Unisa distinguishes between different units including teaching departments, administrative departments, sections, bureau, institutes and centers. The comprehensive unit list for the university consists of roughly one hundred and twenty units. Several iterations through this list reduced the number of units to 59 teaching and 23 non-teaching units that are involved in creating and presenting a learning environment. For the complete list refer to Van der Merwe et al. (2002).

Phase 3: Identify the primary processes

In order to identify the primary processes that pertain to the objectives of the exercise, we initially constructed a draft process list by considering the elements suggested by the starting list described in the methodology, namely *Registration, Course development, Production, Distribution* and *Academic student support.* To identify additional critical processes and remove unnecessary ones, we used a table to assist us in mapping identified primary processes to those on the starting list. Where mapping was not possible, we added the particular primary process to the starting list, and where no element was mapped to a particular item on the starting list, the item was removed from the draft list. We illustrate the mapping procedure with an example.

Because of the similar natures of academic departments, we created a generic academic department, which embodies the typical processes and activities of any academic department. Table 1 lists this generic department with its identified processes.

The first four processes in Table 1 concern the design and construction of learning environments and as a result are considered to be primary, in contrast with general *research,* which is considered to be a support process.

In the next step (see Figure 2), we mapped the identified four processes to those on the starting list: *course development* mapped to *COURSE DEVELOPMENT*. Similarly, *academic student support* mapped to *ACA STUDENT SUPPORT*. However, neither the *assessment* nor the *reflective research* processes matched any process on the starting list and as a result were added to the draft list. We iterated the above procedure for each unit and as a result obtained Table 2 as our deliverable.

As a first step in this phase, we defined the goal and resources for the primary processes identified in phase 2. These are portrayed in Table 3.

For explanatory purposes, we describe the *reflective research* process as found in the first row of the table. We identified *research material* as a basic requirement (input resource) for reflective research, and considered either a documented report, or a research publication as common outputs of this type of research activity. This might not necessarily be the only type of output, since an individual or team who undertook the research, may have gained insight and applied it back into another process without documenting it. The *goal* for this process was to *research a specific topic.*

Phase 4: Construction of the high-level process model

In the next step we associated the primary processes with one another through their respective input and output resources. We used the proposed approach to construct a process-resource table (Table 4), which shows these associations. Table 5 illustrates the subsequent definition of triplets to associate processes and resources with one another.

The implementation of Table 5 led us to the depiction of resources and processes found in Figure 3. As a first step, we drew the eight primary processes with their respective goals. Subsequently, we added the fifteen previously identified resources to the high-level process model, and used the list of triplets to link the different processes with one another through resources, resulting in the high-level process model.

Phase 5: Refine the process model

In this phase we aimed at constructing sub process models to augment the high-level process model of Phase 4 in order to complete our understanding of the application domain. As an example, we only describe the refinement of the *Course development* process.

The *Course development* process contains four sub-processes, namely *New Proposal, Awareness program, Planning,* and *Development* sub-process. Table 6 illustrates the refinement of the *Course development* process.

The association of processes and resources was straightforward, and the resulting process model for Course Development is illustrated in Figure 4. None of the identified sub-processes were atomic, which meant that further refinement was possible. In the same way, following the steps in the proposed methodology can be used to refine each of these processes.

SIMILAR RESEARCH & DISCUSSION

The context of the work described in this paper is very specific to the identified application domain. A literature survey provided useful information in individual steps, but fail to focus specifically on overcoming requirement elicitation costs for this specific application domain. We briefly mention two papers that are representative of the focus that literature has on these issues.

Whittington & Slater (1998) examines the different type of virtual universities and proposed a three layer model for a virtual university. These layers include the organizational layer that represents issues such as structure, copyright and quality assurance; the infrastructure layer that represent certain processes such as registration and payment, but also infrastructures to be established such as discussion and assessment mechanisms, et cetera. The content layer provides the necessary learning space where content is hosted as well as assessment procedures. It is not possible to compare the work of Whittington & Slater to the work presented in this paper as their focus is abstract and not on requirements elicitation. Their aim is to describe the architecture of the virtual institution rather than understanding the processes involved in the traditional institution in order to arrive at a virtual institution.

In their paper, Bruno et al. (1998) define a process engineering methodology to increase the efficiency of college processes and thereby reduce the overhead cost per student. This methodology incorporates two parallel tracks to ensure success, which includes process engineering and change management. Although we recognize the importance of change management, the focus of our methodology does include change management. We therefore do not pay attention to the change management track described by Bruno et al. As a first step in the process-engineering track, processes that have to be re-engineered are identified and relevant resources and constraints are described. In the second step, current processes are analyzed with the intention that the design team gains a deep understanding of the current processes. Bruno et al. provide a table for design teams to gather data by creating a process flow chart to capture the current process and define current process measures; conduct focus groups to document customer performance objectives and issues; and perform best practices benchmarking to identify best practices measures. The third step focus on the design of new processes while the fourth step involves the implementation of the new design. Step five focuses on deployment issues.

These two cases are representative of the literature available on the problem defined in this paper. It is our experience that *requirements elicitation* are handled as a single step (sometimes two steps) in the design of a new model, without meaningful guidelines on how to perform this task efficiently and effectively.

Literature about why projects failed is widely published. Considering the focus of our research, Weaver (2002) summarizes of the ten most common pitfalls causing e-learning failures. We place these failures in two categories namely (1) technological and interoperability complexities, and (2) dissatisfaction, concern, agitation and lack of commitment from the stakeholders. Failures in both these categories can potentially be overcome by understanding the application domain better before making strategic plans to integrate e-learning into the learning program. In our research efforts, we spent months to acquire a comprehensive understanding of one of our application domains, and realized that we needed to capture the essence of our requirements elicitation procedures to simplify our future research efforts. With our theoretical understanding of requirements elicitation and analysis, as well as the practical experience gained from acquiring domain knowledge of a particular application domain, we extracted essential steps and automated activities within these steps. We combined these steps and activities in the methodology proposed in this paper and applied it to several other educational institutions. Application results showed a significant reduction in the time spent on requirements elicitation. Our continuous (and future) research is focused on the efficient integration of e-learning systems into the application domain with measurable success.

We have experienced, and believe that the use of this methodology might assist implementers of e-learning systems to gain a comprehensive understanding of their environment where the intended systems are to be deployed. Such a comprehension might be instrumental in the strategically planning and realizing of e-learning implementations not only to be successful in achieving learning goals, but also to be completely integrated into all critical processes of the institution with positive acceptance from stakeholders.

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FIGURES AND TABLES

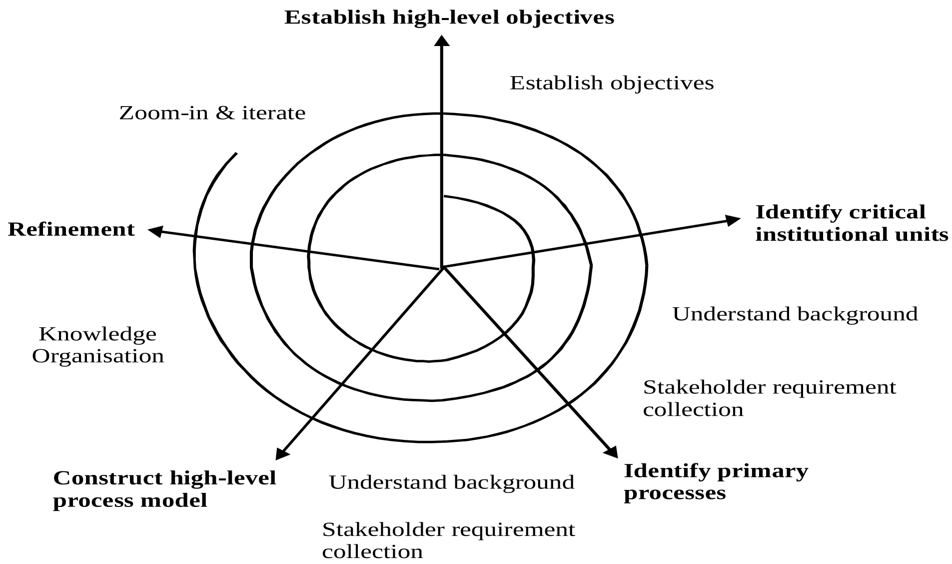

Figure 1 Proposed requirements elicitation methodology

Table 1: The processes within a generic academic department

Units	Process	Prim/Support
Academic department	Course development	P
	Academic student support	P
	Assessment	P
	Reflective research[7]	P
	Research	S

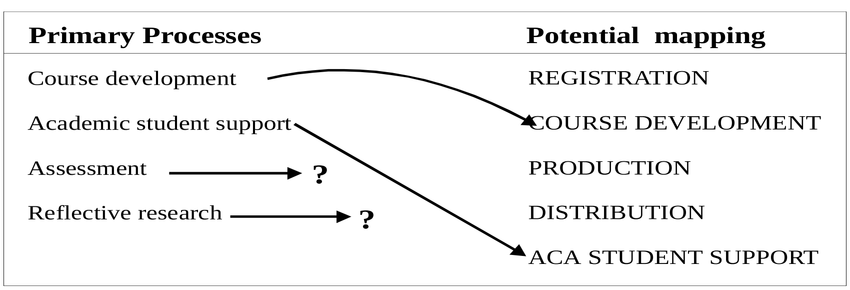

Figure 2 Mapping between primary processes & starting list

[7] Reflective research focuses on course related work, while general *research* refers to subject related research questions.

Table 2 Primary process elicitation at UNISA

Units	Process	Prim/ Support	Mapping
Academic department	Course development Academic student support Assessment Reflective research Research	P P P P S	COURSE DEVELOPMENT ACA STUDENT SUPPORT ASSESSMENT REFLECTIVE RESEARCH
Corporate Communication & Marketing	Marketing Market research	S S	
Undergraduate[8] student affairs	Registration Student administration	P S	REGISTRATION
Examination and Assignment handling	Assessment	P	ASSESSMENT
Bureau of Learning development	Course development Reflective research	P P	COURSE DEVELOPMENT REFLECTIVE RESEARCH
Finances	Student finances Infrastructure finances	S S	
Student Support	Student support	S	
Safety services	Safety	S	
Bureau for Management Information	Prepare management information reports	S	
Catering services	Catering	S	
Building administration	Building maintenance & development	S	
Human Resource	Resource planning & admin Labour relations & Employment equity Human resource development	S S S	
Editorial	Edit study material	P	COURSE DEVELOPMENT
Unisa Press	Compile study material	P	PRODUCTION
Production	Reproduce study material	P	PRODUCTION
Despatch	Distribute study material	P	DISTRIBUTION
Scheduling	Schedule study material for printing	P	PRODUCTION
Unit for video & Sound Photography	Prepare study material	P	COURSE DEVELOPMENT
Documentation	Store identified documentation	S	
Library Services	Provide research material Offer & issue support material	S P	 DISTRIBUTION
Personnel	Personnel support	S	
Computer Services	Student systems Computer services	P S	STUDENT SYSTEMS
Typing centre	Type study material	P	PRODUCTION
Telecommunication Centre	Telecommunication services	S	

[8] Although Postgraduate Studies play a particularly important role in serving a very wide community of students, we omitted it from this report for the sake of simplicity.

Table 3 Primary processes with their resources and goals

Process	Input/output resources	Goal
Reflective research	Input: Research & other material Output: Research report Output: Research publication Output: Knowledgeable individual/team	To gain knowledge or an understanding of a specific topic.
Course Development	Input: Research document[9] Input: Knowledgeable individual/team Output: Study material[10]	To develop study material
Registration	Input: Registration form Input: Academic record Input: Business rules[11] Output: Registered information	To register a student
Production	Input: Study material Input: Student information Output: Study material	To duplicate/print study material
Distribution	Input: Student information Input: Study material Input: Library material Output: List of delivered Material	To deliver study material
Student Systems	Input: Registered information Input: Assessment result Output: Student information	To record student information
Assessment	Input: Study material Input: Exam/assignment paper Input: Student information Output: Assessment result	To assess students' work
Academic Student Support	Input: Student information Output: Problem solution	To provide academic support to students

[9] Report or publication
[10] Study material is any course material developed or compiled by the institution.
[11] Rules and regulations regarding registration as found in the calendar

Table 4 Associations between resources and primary processes

		R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}
		Research & other mat	Research report	Study material source	Business rules	Registration form	Academic record	Registered information	Exam/assignment paper	Assessment result	Student information	List material delivered	Knowledgeable persons	Problem Solution	Study material	Library material
P_1	Reflective research	I	O										O			
P_2	Course development		I	O									I			
P_3	Registration				I	I	I	O								
P_4	Production			I							I				O	
P_5	Distribution										I	O			I	I
P_6	Student Systems							I		I	O					
P_7	Assessment			I					I	O	I					
P_8	Acad Stud Support									I	I			O		

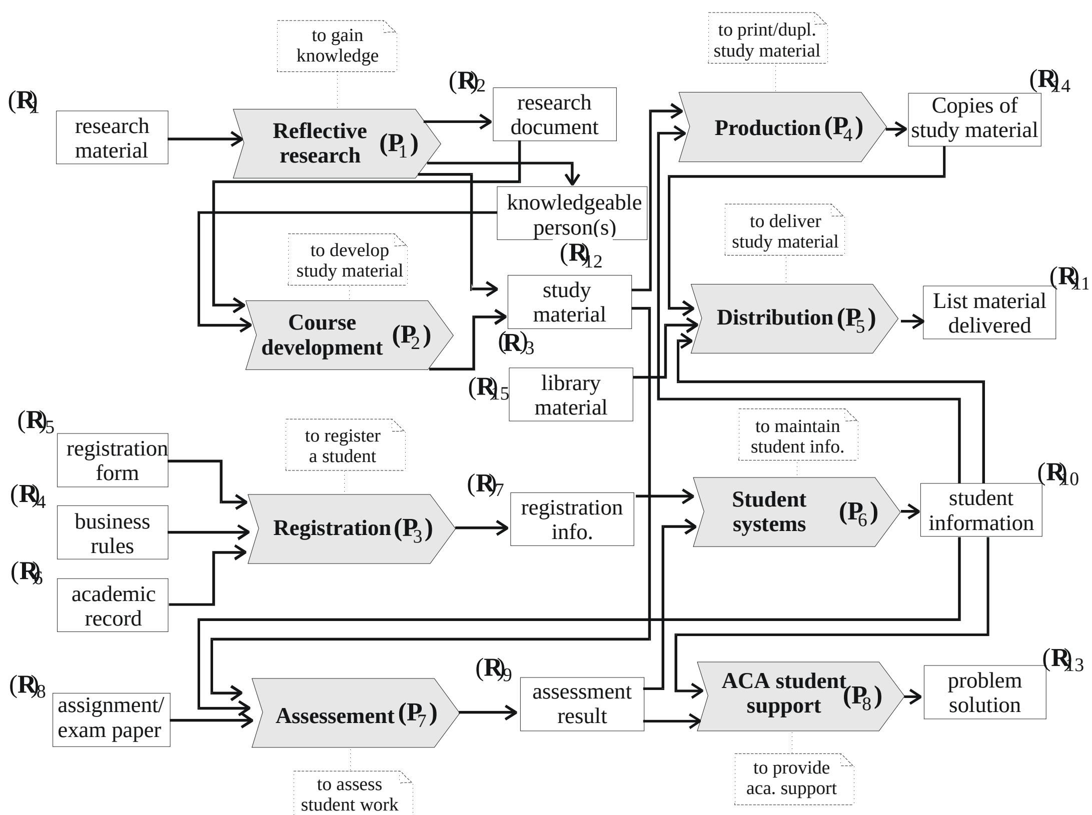

Figure 3: High-level process model

Table 5 Triplets portraying associations between processes and resources

(P_1, R_1,INPUT)	(P_3, R_5,INPUT)	(P_5, R_{11},OUTPUT)	(P_7, R_8,INPUT)
(P_1, R_2,OUTPUT)	(P_3, R_6,INPUT)	(P_5, R_{14},INPUT)	(P_7, R_9,OUTPUT)
(P_1, R_{12},OUTPUT)	(P_3, R_7,OUTPUT)	(P_5, R_{15},INPUT)	(P_7, R_{10},INPUT)
(P_2, R_2,INPUT)	(P_4, R_3,INPUT)	(P_6, R_7,INPUT)	(P_8, R_9INPUT)
(P_2, R_3,OUTPUT)	(P_4, R_{10},OUTPUT)	(P_6, R_9,INPUT)	(P_8, R_{10},OUTPUT)
(P_2, R_{12},INPUT)	(P_4, R_{14},INPUT)	(P_6, R_{10},OUTPUT)	(P_8, R_{13},INPUT)
(P_3, R_4,INPUT)	(P_5, R_{10},INPUT)	(P_7, R_3,INPUT)	

Table 6 Sub-processes, goals and resources for the *Course Development* process

Process	Input/output resources	Goal
New Proposal	Input: Market analysis Output: Course proposal document	To recommend the introduction of a new course
Planning	Input: Course proposal document Output: Development plan Output: List of development team members Output: List of members to attend an awareness program	Compose development plan
Awareness program	Input: List of staff to attend program Output: Knowledgeable team members	To acquire knowledge about specific technologies, strategies & methodologies concerning the course to be developed.
Development	Input: Knowledgeable team members Input: Development plan Output: Course components (source)	To develop course components

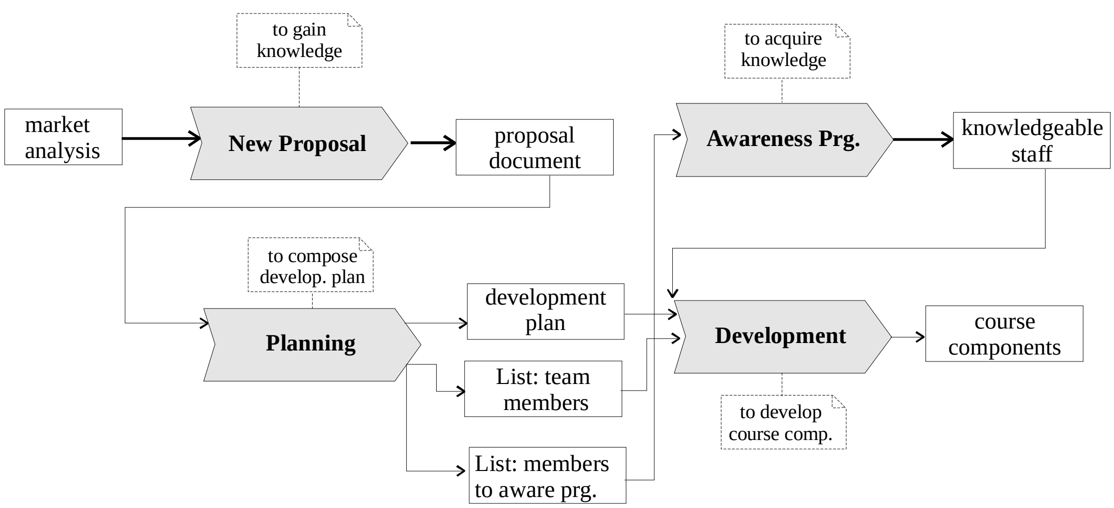

Figure 4 Sub process model augmenting the high-level process model